

Supporting Information

Our results are not sensitive to the choice of U-J values in DFT+U calculations. Table S1 listed the relative energies of LiMn_2O_4 and MgMn_2O_4 different phases using $U=3.9$ and $U=4.8$. In general, the difference is within 10-30 meV. The reason for this insensitivity is that the energies are compared for compounds with the same composition. It does not involve the change of the electronic configuration of the transition metal ion. Thus it is not as sensitive as we compare compounds with different compositions.

Table S1. Relative energies of LiMn_2O_4 and MgMn_2O_4 with different phases.

composition	Phase	Relative energy (meV)	
		U=3.9	U=4.8
LiMn_2O_4	spinel	0	0
	CF	58.4	61.92
	CM	240.1	242.27
	CT	239.9	241.74
MgMn_2O_4	spinel	0	0
	CF	436.1	437.0
	CM	236.1	218.5
	CT	326.1	324.2